New and unidentified Species of Synchytrium. - III.

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In previous publications (1955, 1956) I described eight new and several unidentified species of *Synchytrium* on unrecorded hosts from Argentina, Canada, and California, Idaho, Oregon and Washington, U.S.A. Inasmuch as it was often impossible to determine the full life cycle of these species in herbarium material most of unidentified ones are incompletely known, and for this reason I did not give them specific names. The present paper concerns additional new and unidentified species which have been found in various herbaria since that time. These fungi were studied first from dried herbarium material, after which they were soaked in water, fixed in a vacuum to remove the air, embedded, sectioned, and stained, as was reported in the previous papers.

Synchytrium shawii sp. nov.

Sporis perdurantibus sphaericis, 70—102 μ , ovalibus, 78—85 \rightleftharpoons 98—108 μ ; parietibus fuscis, levibus, 4.8—5.2 μ crassis; germinatio ignota. Specimen typicum in Herb. State Coll. Wash. No. 38539.

Resting spores usually solitary up to 5 in a cell, spherical, 70–102 μ , or ovoid, 78–85 \rightleftharpoons 98–108 μ , with a smooth, reddish-brown wall, 4.8–5.2 μ thick, and coarsely granular content; enveloped by a layer of reddish-brown residue which may fill remainder of host cell; germination unknown.

Simply monogallic, resting-spore galls scattered or crowded, hyaline when young, becoming reddish-brown with old age, broadly clavate and obpyriform, 220—322 μ high by 188—210 μ in broadest diam., oval, 132—138 \rightleftharpoons 158—192 μ , oblong, 150—168 \rightleftharpoons 216—228 μ , or subspherical, 133—150 μ ; wall of host cell 5—6.5 μ thick; apex and sides invaginating when galls dry out to become cup-shaped and sometimes polyhedral.

On leaves, petioles, trichomes and stems of Androsace occidentalis, Northville, South Dakota, U.S.A. (leg. J. F. Brenckle, 5-29-1935).

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This fungus was discovered and identified as a species of Synchytrium by C. G. Shaw when he examined the herbarium specimens of the host collected by Brenckle, and it is named after him in appreciation of his generosity to me. Sporangia are not present in this material, and S. shawii appears to be short-cycled and a member of the subgenus Pycnochytrium. So far S. aureum is the only species reported on a member of the Primulaceae, Androsace chamaejasme, but S. shawii differs from it by inducing simple galls. In this respect it causes the same reaction in its host as S. myosotidis, S. cupulatum, S. potentillae, S. echii and S. pyriforme of the same subgenus.

Synchytrium macrosporum sp. nov.

Sporis perdurantibus sphaericis, $150-270 \mu$, ovalibus, $130-180 \rightleftharpoons 200-260 \mu$; parietibus levibus, $5-6 \mu$ crassis, intus pallide brunneis, germinatione ignota. Specimen typicum in Herb. New York Bot. Gard. no. 777.

Resting spores solitary or sometimes 2 in a cell, spherical 150– 270 μ , or ovoid, 130–180 \rightleftharpoons 200–260 μ , with a reddish-brown, smooth wall, 5–6 μ thick, and light mustard-yellow content; residue around spores sparse or lacking; gemination unknown.

Compositely monogallic, resting-spore galls usually scattered, sometimes crowded and confluent, usually lavender-red or violet, largely superficial on host and protruding conspicuously, crateriform or sunken at apex, 400–600 μ high by 350–550 μ broad; sheath 4–6 cells thick, sheath cells greatly enlarged and thick-walled.

On leaves and petioles of Xanthium strumarium, Austin, Tex., U.S.A. (Leg. W. H. Long, 6-16-1901).

This is the first species to be reported on Xanthium, and it appears to be short-cycled and a member of the subgenus Pycnochytrium. Its largest resting spores surpass in diameter those of most species, and because of this as well as the large galls which it induces it is named macrosporum. Its smaller spores, however, fall within the size range of those of several species of Pycnochytrium. On the petioles the galls may be largely confluent and form conspicuous reddish-lavender crustes similar to those described by $P \circ o l e$ (1954) on Riccinus communis at Cameron, Texas. Possibly, the two species are identical.

A similar species was collected (?) by W. H. Long, Jr., 1900—1901, in Texas on *Gerardia* (?) which is deposited at Cornell University (no. 772). It causes very large, $420-530 \mu$ high by 510— 602 μ broad, protruding composite resting-spore galls whose sheath cells are greatly enlarged, globular and thick-walled. Its resting spores are spherical, 105—210 μ , with yellow content and a darkamber to amber-brown wall, 3.5—4.8 μ thick. These are smaller than ^{©Verla}the spores of S. *macrosporum*, but otherwise the two species are very un at similar in appearance.

Synchytrium lacunosum sp. nov.

Synchytrium sp. Raper and Cooke, 1954. Mycologia 46: 675.

Sporis perdurantibus, sphaericis, $102-140 \mu$, ovalibus, $90-126 \rightleftharpoons 150-204 \mu$; pariete minute punctato, $4-6 \mu$ crasso; germinatione ignota. Specimen typicum in Herb. State Coll. Wash., Pullman, no. 31273.

Resting spores solitary or up to 5 in a cell and filling it only partly, spherical, $102-140 \mu$, usually elongately ovoid, $90-126 \rightleftharpoons 150-204 \mu$, with a dark-amber, deeply and minutely pitted or punctate wall, $4-6 \mu$ thick, and brilliantly yellow content; usually not enveloped by residue; germination unknown.

Compositely monogallic, resting-spore galls usually confluent, frequently producing conspicuous outgrowths up to 800 μ diam., isolated single galls protruding conspicuously and largely superficial, base often constricted, subspherical, almost hemispherical to mound-shaped, 252–480 μ high by 336–600 μ broad, with a narrow apical crater, up to 30 μ diam.; sheath 3–6 cells thick, walls of inner sheath cells up to 12 μ thick.

On leaves petioles and stems of *Draba verna*, Salty Creek, Medicine Bow Mts., Albany Co., Wyoming, U.S.A. (leg. C. G. Shaw, 7-12-1950), causing stunting of leaves, outgrowths and malformations.

This species resembles S. lepidii Cook (1945 a) on Lepidium virginicum by its spore and gall sizes, the thick-walled and lignified inner sheath cells, and the malformations or outgrowths which it may cause on its host. However, it differs by the minutely and deeply pitted or punctate character of the spore wall, and for this reason I believe it is a different species. I have repeatedly examined the resting-spore wall of S. lepidii in C o o k's material for comparison, but have failed to find it sculptured or pitted. This minutely pitted structure in S. lacunosum is very distinct and sharply-defined because of the lack of residue around the resting spore, and the so-called pits appear to extend almost to the endospore as minute canals. The thickening and lignification of the walls of the inner sheath cells is very characteristic of the galls, and may involve the walls of 1 to 3 cells in depth, forming thusly a deep-staining and sharply-defined layer of cells around the infected one.

Another very similar fungus was collected by S h a w on *Lepi*dium draba, at Salty Creek, 6-12-1050, Albany Co., Wyoming (spec. no. 35089, State Coll. Wash.). It has the following characteristics: Resting spores usually solitary and partly filling host cell, spherical, 60—168 μ , or ovoid, 102—123 \Rightarrow 108—156 μ , with a dark-amber, minutely pitted or punctated wall, 3—4 μ thick, and yellow in content; ^{©Verla} enveloping residue sparse or usually lacking; germination unknown. Compositely monogallic, resting-spore galls usually scattered, sometimes crowded and confluent, greenish-yellow, later becoming lemonyellow and dark, protruding conspicuously and largely superficial on both surfaces of leaf, 204–268 μ high by 216–294 μ broad with a shallow apical crater; sheath 3–4 cells thick, walls of inner sheath cells thickened.

It is obvious from the above description that this species is very similar to S. lacunosum, and for the time being and I regard the two fungi as identical. The only differences noted were the lack of malformation and distortion of the host, L. draba, and less thickening of the inner sheath cell walls of the galls on this host. The only other species reported to have punctate or pitted spore walls is S. punctatum, but this species is simply monogallic and develops larger resting spores than S. lacunosum and has hyaline contents.

Recently Dr. G. B. Cummins, 8-16-1955, collected a species on Arabis sp. in Glacier Park, Montana, which appears to be S. lacunosum. In the region of confluent galls the leaves may become up to 800-1200 u thick, and the host reactions are very similar to those caused by S. lacunosum. Its resting spores are usually solitary but sometimes 2 or 3 may occur in the infected cell. These fill the cell only partly and are oval, $43-96 \rightleftharpoons 14-197 \mu$, or spherical 98-120 μ , or occasionally oblong $78-130 \rightleftharpoons 150-182$ µ, with a pitted wall, 3-3.8 µ thick, and yellow content. The enveloping residue is relatively sparse. Most of the spores are immature and not as clearly pitted as in S. lacunosum on Draba verna. The galls which it causes are separate and scattered but more commonly crowded and confluent, protrude conspicuously, subspherical to hemispherical, 229-364 µ high by 338–420 μ broad, with a sheath 4–6 cells thick. The sheath cells adjacent to the infected one are greatly enlarged with thick and lignified walls, while the outer cells are smaller and thin-walled. The apical crater is narrow, up to 30 µ diam., and inconspicuous. Although the wall of the resting spores is not as conspicuous lacunate as that of S. lacunosum on Draba verna I believe the two fungi are identical.

Synchytrium Species in Veronica.

Up to the present time three species of Synchytrium have been reported on Veronica: Synchytrium globosum on V. anagallis, V. beccabunga, V. chamaedrys, V. peregrina and V. scutellata in Germany, Sweden, Denmark, Iceland and Louisiana, U.S.A. by Schroeter (1870, 1885), Rostrup (1903), Larsen (1932), Hammarlund (1932) and Cook (1945 b, c), respectively; S. johansonii on V. scutellata in Sweden by Juel (1893), and Synchytrium sp. on V. alpina ^{©Verla}in [©]Wyoming [©]by Raper and Cooketr(1954). In addition to these use at hosts, *Veronica hemifusa* and *V. peregrina* var. *xalapensis* are parasitized by *Synchytrium*, according to herbarium specimens at the State College of Washington.

Synchytrium sp. on Veronica alpina.

Resting spores solitary or up to 4 in a host cell and filling it only partly, usually ovoid, $80-102 \rightleftharpoons 110-128 \mu$, or spherical, 54-132 μ , with a brownish smooth wall, 2.8-3 μ thick and yellowish content; enveloping residue sparse or lacking; germination unknown.

Compositely monogallic, resting-spore galls separated and scattered or crowded and confluent, usually protruding conspicuously, greenish-white at first but becoming faintly lavender with age, subspherical or globose with a constricted base, $193-264 \mu$ high by $200-270 \mu$ broad or almost hemispherical on surface of leaf, 132- 170μ high by $200-240 \mu$ broad with a shallow apical crater; sheath 4-6 cells thick, walls of sheath cells thickened.

On leaves, petioles and stems of *Veronica alpina*, Mirror Lake, Albany Co., Wyoming, U.S.A. (leg. C. G. Shaw, 8-9-1950; specimen no. 31278, State Coll. Wash.).

This is the fungus which R a p e r and C o o k (1954) reported but did not describe from the 1950 mycological foray in Wyoming. Its spores and galls occur abundantly on both surfaces of the leaves and may cause the latter to become up to 360μ thick where the galls are confluent. The trichomes on the stems are frequently infected and become greatly swollen. Normal trichomes are $18-24 \mu$ in diameter but the infected ones may be up to 150μ thick, septate in several planes, and composed of a great number of cells. Apparently, the parasite causes the infected cell and its subsequent derivatives to divide several times.

Only resting spores are present in S h a w's material and this fungus appears to be short-cycled. The spores fall within the size ranges of those of S. globosum, but most of them are slightly larger than those of the latter species which also occurs on Veronica. Whether or not the present species is identical to S. globosum cannot be determined with certainty until it has been studied more intensively and host range studies have been made. The galls induced by both species are similar in structure but those on V. alpina are usually smaller with a thicker sheath than those caused by S. globosum. Also, the content of the resting spore of the latter species is hyaline, according to S c h r o e t e r (1870), whereas in the present species it is light-yellow. I have attempted to germinate the resting spores of the species on V. alpina without success, and it is not known if they function in the same manner as those of S. globosum. ©Verlag Ferdinand Berger & Söhne Ges.m.b.H., Horn, Austria, download unter www.biologiezentrum.at Synchytrium sp. on Veronica hemifusa.

Resting spores solitary, spherical, 75–90 μ , with an amber, smooth wall, 3–3.8 μ thick, and lemon-yellow to almost hyaline content; enveloping residue sparse; germination unknown.

Compositely monogallic, resting-spore galls separate and scattered but more frequently crowded and confluent, yellowish-green when young but becoming faintly lavender-red to lavender-violet with maturity; protruding conspicuously, almost hemispherical or domeshaped on surface of leaf, 190–252 μ high by 220–288 μ broad, with a shallow apical crater; sheath 4–5 cells thick.

On leaves, petioles and stems of *Veronica hemifusa*, Neals Sect. 3, border of Umatilla Natl. Forest, Garfield Co., Washington, U.S.A. (leg. C. G. Shaw, 5-21-1951; spec. no. 31285, State Coll. Wash.), causing stunting, thickening and distortion of young leaves.

This fungus resembles the previous one on *V. alpina* from Wyoming, and it is quite possible that they are identical. The resting spores of both fungi as well as the galls which they induce are fairly similar in size, structure and appearance.

Another species in the herbarium of the State College of Washington (no. 34614) was collected on *Veronica hemifusa* in the Wenatchee Mts., Washington, at an altitude of 5300 ' by an unknown collector, 7-1904. This fungus differs from the above species on the same host from Garfield Co. by its large resting spores and galls, and appears to be a different species. Its characteristics are as follows: Resting spores usually solitary, spherical 94—180 μ , with an amber, smooth wall, 4 μ thick, and yellow content; enveloping residue sparse; germination unknown. Compositely monogallic, resting-spore galls separate and scattered or crowded and confluent protruding conspicuously, dark-lavender to lavender-violet, sub-spherical, 360— 560 μ broad; sheath 5—8 cells thick.

Synchytrium sp. on Veronica peregrina var. xalapensis.

Resting spores solitary, partly filling host cell and enveloped by a sparse or fairly abundant amount of residue, spherical, 56– 123 μ , or ovoid, 54–132 \rightleftharpoons 66–174 μ , with a smooth, brown wall, 4–4.5 μ thick, and bright yellowish-orange content; germination unknown.

Compositely monogallic, resting-spore galls sparse and scattered, brown, protruding conspicuously, almost hemispherical or domeshaped on surface of leaf, $168-282 \mu$ high by $150-384 \mu$ broad, with a shallow apical crater; sheath 5-8 cells thick.

On leaves and petioles of *Veronica peregrina* var. *xalapensis*, Sacramento Co., Calif., U.S.A. (leg. H. L. Mason, 3-25-1934; specimen no. 37897, State Coll. Wash.). ©Verlag Ferdinand Berger & Söhne Ges.m.b.H., Horn, Austria, download unter www.biologiezentrum.at

This fungus was recognized as a species of *Synchytrium* by C. G. S h a w when he examined the herbarium specimens of the host for fungi. Only a small amount of material was available for study and this contained only resting spores. Apparently, this is not the same species which Cook (1945 a and c) reported as S. globosum on V. peregrina in Louisiana. His fungus develops sporangial sori and obviously is a long-cycled species.

In connection with these species on Veronica it may be noted that in examining herbarium specimens of V. scutellata collected by J. B. Moyle, 7-13-1933, Itasca Park, Clearwater Co., Minnesota, C. G. Shaw found a fungus which he recognized as a Synchytrium species (specimen no. 37887, State Coll. Wash.). It has the following characteristics: Resting spores usually solitary and filling host cell almost completely, small, spherical, 25-55 µ with a smooth wall, $2.8-3.2 \mu$ thick, and almost hyaline content; enveloped by a reddishbrown compact layer of residue which may fill remainder of host cell; germination unknown; compositely monogallic, resting-spore galls minute on both surfaces at tips of leaves, usually separate but crowded, protruding only slightly, 80-100 high by 130-180 µ broad; sheath 1-3 cells thick. This may prove to be S. johansonii, and in that event this is first report of its occurrence outside of Sweden. A specimen, no. 157589, on Pedicularis lanceolata (leg. J. M. Bates, 9-25-1908, Howard Co., Neb.) in the herbarium of the University of Nebraska is labelled S. johansonii, but I found it to be a mycelioid fungus and not Synchytrium.

Synchytrium sp. on Parnassia fimbriata.

Resting spores usually solitary, partly filling and lying in base of infected cell, or filling it almost completely, spherical, 150–180 μ , with a smooth, dark amber-brown wall, 3.8–4 μ thick, and brilliant dark-yellow content; enveloped usually by a very sparse amount of residue; germination unknown.

Compositely mongallic, resting spores usually scattered and separate, sometimes crowded and confluent, yellowish-brown, broadly dome-shaped or hemispherical, $264-340 \mu$ high by $380-576 \mu$ broad with a distinct apical crater; sheath 4-6 cells thick, sheath cells greatly enlarged and thick-walled but not lignified, cells at apex elongated outward, clavate and flared out, forming a rosette around apical crater, filled with a yellowish-brown substance which gives galls their characteristic color. Spec. no. 37527, State Coll. Wash., Pullman.

On leaves of *Parnassia fimbriata*, Granite Creek, Roosevelt Grove, Wash., U.S.A.

The host of this species was collected by R. F. Daubenmire, 8-11-1947, and in examining it for fungi C. G. Shaw found this spe-

©Verlag Ferdinand Berger & Söhne Ges.m.b.H. Horn, Austria, download unter www.biologiezentrum.at cies of Synchytrium. It is very conspicuous on both surfaces of the leaves by its large yellowish-brown galls, but it does not cause distortion and malformation of the host. Its resting spores fall within the upper size ranges reported for S. aureum by Schroeter (1873) and Rytz (1907), but it is not certain that it is identical to this species. The induced galls are larger than those usually caused by S: aureum, but this may be due to a difference in host reaction. Synchytrium aureum was reported on Parnassia palustris by J u el (1893) in Sweden, but since he did not describe his fungus it is impossible to compare it with the present fungus. A similar species was collected and identified as S. aureum by C a l d er and S a v i l e, 8-2-1953, on P. parviflora near Windermere, B. C. It may prove to be identical to the present species, but so far at it is known, it induces smaller and less conspicuous galls.

Synchytrium sp. on Gentiana oregana.

Resting spores usually solitary, sometimes up to 3 in a cell and filling it only partly, subspherical, 90–144 μ , or ovoid, 80–100 \rightleftharpoons 120–130 μ , with a smooth wall, 2.8–3 μ thick, and faintly-yellow to hyaline content; enveloping residue sparse or lacking; germination unknown.

Compositely monogallic, resting-spore galls separate and scattered or crowded and confluent, greenish with the hyaline to faintly yellow spores showing through sheath, usually dome- or mound-shaped with a shallow apical crater, $168-240 \mu$ high by $312-408 \mu$ broad, sometimes protruding almost equally on both sides of leaf, or only on one side; sheath 4-6 cells thick, sheath cells greatly enlarged.

On leaves of *Gentiana oregana*, Neal Sect. 3, border of Umatilla Natl. Forest, Garfield Co., Wash., U.S.A. (leg. C. G. S h a w, 5-21-1951; spec. no. 31286, State Coll. Wash.).

This species was collected in close proximity to the ones on *Thalictrum occidentale* (Karling, 1956 c), *Veronica hemifusa*, and *Fragaria cuneifolia* described below in a plowed field in Neal's Sect. 3 at the boundary of the Umatilla Natl. Forest. All appear to be short-cycled, compositely monogallic species whose resting spore content is almost hyaline to faintly-yellow in color. Although their resting spores and galls vary in size, the differences are not very great, and it is possible that these species might be identical. However, this remains to be proven from more intensive morphological, developmental and host range studies.

Except for its smaller and almost hyaline spores the species on *G. oregana* is very similar to one which Calder, Savile and Ferguson collected on *Gentiana sceptrum* near Prince Rupert, ©Verlag Ferdinand Berger & Söhne Ges.m.b.H., Horn, Austria, download unter www.biologiezentrum.at

British Columbia (K a r l i n g, 1956 b). So far only one other species, S. aureum, has been reported on members of the Gentianaceae: namely Gentiana campestris (J u e l, 1893) and Halena deflexa (D a v i s, 1924). None of these investigators, however, described their fungi, and it is difficult to compare them with the Washington and Canadian species.

Synchytrium sp. on Fragaria cuneifolia.

Resting spores usually solitary and filling only part of host cell, spherical, 72–102 μ , or ovoid, 66–84 \approx 96–120 μ , with a smooth wall, almost hyaline to faintly yellow content; enveloped by a sparse to fair amount of residue; germination unknown.

Compositely monogallic, resting-spore galls very abundant, separate but close together, frequently confluent, usually protruding conspicuously, brilliantly lavender-red when mature, dome- to mound-shaped, hemispherical or subspherical, $195-374 \mu$ high by 220-468 μ broad, with a shallow apical crater or depression; sheath 4-8 cells thick, sheath cells enlarged.

On leaves, petioles and stems of *Fragaria cuneifolia*, Neal's Sect. 3, Garfield Co., Wash., U.S.A. (leg. C. G. Shaw, 5-21-1951; spec. no. 31276, in herb. State Coll. Wash.).

This fungus is very abundant on the underside of leaves and may cause marked thickening in the regions where the galls are confluent. The resting spores in S h a w's collection appear to be immature because they are relatively thin-walled, $1.8-2.6 \mu$, and lack the commonly present coarse granules and globules in their cytoplasm. Also, the host nucleus is present in a layer of cytoplasmic residue around the port.

This species resembles the previous one and may be identical to it. Also, it may be identical to the S. aureum which Davis (1932) reported but did not describe on F. virginiana in Wisconsin. A similar species was collected by H. M. Fitzpatrik, 7-19-1927 (Spec. no. 9911, Cornell Univ.) on F. virginiana at Ithaca, N. Y. and identified as S. aureum by H. S. Jackson. Its resting spores are oval, $108-130 \rightleftharpoons 127-160$ µ, or spherical, 98-186 µ; with a relatively thin amber wall and light-yellow content. The galls are separate and scattered, or crowded and confluent and very abundant on both surfaces of the leaves, petioles and stem. They protrude conspicuously and are mound-shaped, 220-260 u high by 320-350 u broad, with a sheath 2-4 cells thick. Although its spores may be larger than those of Shaw's fungus, I believe these fungi are identical. Zeller and Campbell's (1949) S. fragariae on Fragaria sp. develops sporangial sori, causes large nodules on the roots, and appears to be different from the present species.

©Verlag Ferdinand Berger & Söhne Ges.m.b.H., Horn, Austria, download unter www.biologiezentrum.at Synchytrium sp. on Lupinus leucopsis.

Resting spores usually solitary, subspherical, 70–90 μ or 86–90 \rightleftharpoons 101–108 μ , with an amber, smooth wall, 2.8–3.2 μ thick, and yellowish-orange content; enveloping residue sparse; germination unknown.

Compositely monogallic, resting-spore galls usually crowded and confluent, sometimes scattered and separate, yellowish-green, not protruding conspicuously, low and mound-shaped, or subhemispherical, 166—180 μ high by 208—240 μ broad.

On leaves, petioles, stems and flowers of *Lupinus leucopsis*, Boiling Lake, Chelan Co., Wash., U.S.A. (leg. C. G. S h a w, 7-20-1950; spec. no. 28377, State Coll. Wash.).

This species is unusually abundant, attacks all aerial parts of the host, and causes curling, distortion, and stunting of young leaves and flowers when they are heavily infected. However, no infection of trichomes has been noted. Another species on *Lupinus rivularis* was collected by Calder, Savile and Ferguson, 9-9-1954, at an altitude of 6000' on the east slope of Frosty Mountain in Manning Province Park, B. C. and described briefly by me (1956 b). It infects leaf trichomes very readily and causes much larger broadly coneshaped or slightly fusiform galls.

Synchytrium sp. on Claytonia megarrhiza.

Resting spores usually solitary and filling host cell only partly, spherical, 70–120 μ , or ovoid, 60–70 \rightleftharpoons 72–78 μ , with a smooth wall, 3.5 μ thick, and reddish-yellow content; enveloped by reddish-brown residue; germination unknown.

Compositely monogallic, resting-spore galls usually scattered, sometimes confluent, orange-red to lavender-red, mound-shaped with a shallow apical crater, 195–288 μ high by 240–354 μ broad; sheath 3–4 cells thick, sheath cells greatly enlarged and filled with a light-lavender-red pigment.

On leaves and flowers of *Claytonia megarrhiza*, Upper Soapstone, Summit Co., Utah, U.S.A. (leg. K. H. McKnight, 7-1-1955; spec. in herb. Purdue Univ.).

This fungus was discovered while I (1956) was studying a *Physoderma* species on this host which had been sent to me by Dr. K. H. McKnight. It is slightly larger but otherwise similar to another *Synchytrium* collected by I. L. Conners and J. A. Parmelee on *Claytonia virginica* near Malden Centre, Essex Co. Ontario, which will be described by D. B. O. Savile. It is possible that they might prove to be identical.

Synchytrium sp. on Engelmannia pinnnatifida.

Resting spores solitary or up to 3 in a cell and partly filling it, spherical, 96–132 μ , or ovoid, 48–132 \rightleftharpoons 55–150 μ with a smooth

©Verlagdark-amber to amber brown wall, 5437 µ thick, and yellow content, mat enveloping residue usually sparse or lacking, or filling remainder of cell; germination unknown.

Compositely monogallic, resting spore galls abundant on lower surface of leaves and along midribs, separate and scattered or frequently crowded and confluent, dome- or mound-shaped, 162–240 μ high by 168–270 μ broad, partly embedded in host tissue; sheath 1–3 cells thick.

On leaves of *Engelmannia pinnatifida*, College Station, Texas, U.S.A. (leg. H. S. Jennings, 4-26-1890; spec. no. 105 in herb. N. Y. Bot. Garden).

This is the first species to be reported on this host. Only resting spores are present in Jenning's material, so this species is described as a short-cycled one and included provisionally in the subgenus *Pycnochytrium*. One striking characteristic of the galls is the wall of the infected cell which may be up to 13 μ and hyaline. This cell is usually somewhat flagon-shaped, and when the galls are dissected it and the resting spore come out intact. The sheath cells may extend only partly around the host cell with the result that the upper portion of it is exposed.

Summary.

Three new short-cycled species, Synchytrium shawii, S. macrosporum and S. lacunosum were found on Androsace occidentalis, Xanthium strumarium, Lepidium virginicum and L. draba, respectively, from South Dakota, Wyoming and Texas. All develop only resting spores and are placed temporarily in the subgenus Pycnochytrium. Synchytrium shawii is simply monogallic while the other two species are compositely monogallic in relation to their hosts. Eleven additional short-cycled, compositely monogallic species were found on Veronica, Parnassia, Gentiana, Fragaria, Lupinus, Engelmannia and Claytonia in Utah, Washington, California, Texas and Wyoming and are described. Inasmuch as their life cycles are only partly known they are not given specific names.

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